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POLARITON CONDENSATION IN A DISORDERED POTENTIAL

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We study polariton condensation under OPO (Optical Parametric Oscillator) out-of-equilibrium conditions [1] in the presence of linear and point defects. Because of the simultaneous presence of pump, signal and idler emitting at different wave vectors, as well as of photonic disorder, the system is characterized by currents carrying polaritons from loss-dominated regions to gain-dominated regions and by the presence of pinned vortices-antivortices (V-AV). A spatial-, momentum- and energy-resolved analysis of the emission from linear defects evidences their high efficiency for trapping polaritons. Furthermore, a detailed study of the condensate phase demonstrates that the map of the supercurrents is unambiguously determined by the different defect geometries.

We have studied two similar λ/2 GaAs-based microcavities, differing mainly by the thickness of the cavity and of the quantum well placed at the electromagnetic field antinode. For sample A (B) the well thickness is 20 nm (25 nm) yielding a Rabi splitting Ω_R=4.4 meV (4.2 meV). The samples are kept at 10 K and excited with a Ti:Al_2O_3 laser under OPO conditions.

Figure 1 (a) shows the spatial emission of a linear defect in sample A at the middle of a surrounding 2D OPO condensate. A spectral analysis of the real space emission (Fig. 1 (b)) resolves the 2D emission (1.5505 eV) and that of the 1D condensate (1.5500 eV). The linear defect separates the 2D condensate in two parts, each one of them having a different finite momentum pointing towards the low energy defect (not shown), implying that the polaritons are flowing into it. This flow provides an extra mechanism for achieving 1D condensation. Figure 2 depicts the emission of sample B where point defects induce pinning of V-AV. An analysis of the OPO signal interferences obtains a map of the polariton-cloud phase, and its numerical gradient leads to the determination of the supercurrents, pointing towards gain dominated regions.

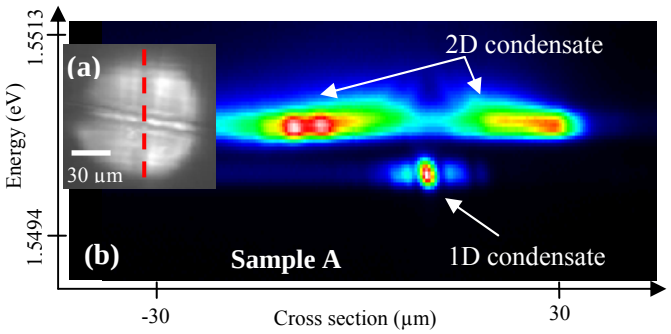

Figure 1: (a) Emission of sample A in grey scale: the linear defect is observed as a quasi-horizontal line. (b)Energy resolved emission along the red dashed line shown in (a).

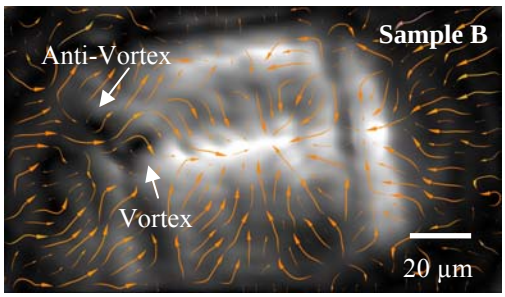

Figure 2: Emission of the sample B shown in grey scale. The orange arrows represent the supercurrents in the polariton OPO flowing through a defect, from loss to gain regions.

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